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BURIED BEDROCK VALLEYS EAST OF JOLIET AND THEIR RELATION TO WATER SUPPLY[1]

By

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Introduction

Most of the Mississippi Valley region north of Ohio and Missouri rivers has a mantle of glacial drift which overlies the bedrock. Hence, throughout this region there are two topographies, one on the unconsolidated surface materials and the other on the bedrock. The surface topography is the present landscape and is well known, but the older landsurface buried beneath the drift is not so well known. However in many places in Illinois, information derived from well records and other sources reveals the presence of buried valleys whose existence would not be suspected from the present surface topography.

[1] Read before the Illinois Water Well Drillers Association, February 25, 1943.

The valleys are of practical value as well as of scientific interest because they not uncommonly contain fills of sand and gravel which constitute conduits and reservoirs for large quantities of excellent water. This is especially important in the central and southern parts of Illinois where the underlying bedrock is largely shale and so is often barren of water or has water of undesirable quality. Water in the glacial drift is usually of good quality and may be produced at relatively low drilling and pumping costs. The problem in its utilization is commonly that of locating subsurface reservoirs large enough to meet the demands. Buried valleys have provided the solution to this problem in many areas, and the State Geological Survey has successfully located a number of them for cities and villages by electrical earth-resistivity surveys.

The numerous well records available for northeastern Illinois, where there is a large population, enable partial reconstruction of the ancient landscape. One of the purposes of this brief report is to provide some idea about the local bedrock valley-system near Joliet. Here the underlying bedrock is dolomitic limestone having uniformly high porosity, and most of the shallow wells secure water from it. However, the glacial gravels that partially fill the bedrock valleys constitute a potential reserve of additional groundwater supplies.

Study of Well Records

The preliminary study in the Joliet area consisted of the assembly of available well records, the determination of the locations and ground-surface elevations of the wells, and the computation of bedrock elevations by subtracting drift thicknesses from ground elevations. The bedrock elevations were then plotted on a map and these formed the basis for a contour map showing the topography of the buried landsurface (pl. 1). About 350 well records were used in making the bedrock-surface map. In the early phases of study it was noted that several wells east of Joliet passed through the unusual thicknesses of 150 to 200 feet of glacial drift before encountering bedrock. These wells are along the valley of Spring Creek and are roughly aligned in an east-west direction. When bedrock elevations were plotted and contoured, a large bedrock valley was revealed.

Earth Resistivity Survey

Of importance in further search for the location of valleys in the bedrock was an electrical earth-resistivity survey. This is based upon the fact that clay, glacial till, and shale offer less resistance to the passage of an electric current through them than do limestone, sand, and gravel. Resistivities at various depths are obtained by varying the spacing of electrode stakes at the surface, so that a series of readings may be made at a station to test the

resistivity at various depths. Such readings taken at uniformly spaced stations throughout an area provide data upon which regional geologic interpretations may be made. These interpretations are most valid where resistivity values can be checked and calibrated against well records and bedrock and drift exposures.

In the Joliet area a close correlation between resistivity and other data was possible because of the wealth of geologic information available. It was found that sand and gravel deposits gave resistivity values somewhat lower than the limestone bedrock but considerably higher than glacial till. Approximate elevations were determined for the top of the sand and gravel or for the bedrock surface where the sand and gravel is absent. A map showing the thickness of sand and gravel deposits (pl. 2) was constructed on the basis of resistivity determinations and well records.

Bedrock Surface

Some idea of the landscape which existed before the glacial drift was deposited may be obtained by studying regions where the drift is absent--the so-called "driftless areas." These unglaciated regions are present everywhere beyond the limits of glaciation south of Ohio and Missouri rivers, but they are also found within the central part of the drift-covered Mississippi Valley region. The old lead district of northwestern Illinois near Galena is topographically different from most of the rest of the State, because no glacial drift is present and the eroded bedrock surface lies directly under a thin mantle of soil. The limestone bedrock in this district has a similar composition to that which underlies the drift at Joliet, and the landscape features are doubtless very similar to those that lie buried beneath 50 to 350 feet of drift in northeastern Illinois. The valleys are relatively large and steep-walled as compared with those in glaciated areas, and the general aspect of the region is decidedly rugged. Instead of broad uplands there is a succession of winding ridges capped in places with irregular mounds. This in a general way describes the bedrock topography of the Joliet area as interpreted from subsurface data (pl. 1).

Two major drainage systems in the bedrock were present in northeastern Illinois--one represented by valleys which drained eastward toward the present basin of Lake Michigan and the other, roughly coinciding with present Illinois River which included valleys that drained south and west. The watershed between these two systems crossed the eastern part of the Joliet area and is revealed by a narrow "upland" of high bedrock now buried by glacial drift. The conspicuous rock ledges near Lemont are the result of trenching of this ancient divide by glacial waters escaping through Sag Channel and the Des Plaines Valley.

Two large bedrock valleys east of Joliet roughly coincide with the present valleys of Spring Creek and Hickory Creek and a third, called Hadley bedrock valley, forms a connecting channel between the two (pl. 1). The three channels surround an island-like upland in east Joliet which rises 100 feet above bedrock valleys on all sides. The valleys are about a mile wide, have relatively steep sides, and average 100 feet in depth. The longest valley is that along Spring Creek which extends eastward from Joliet for a distance of at least 10 miles. Numerous tributaries of all dimensions are indicated and have been outlined largely on the basis of the resistivity survey. Flat uplands appear to be absent, so that even in closely spaced wells the elevations of bedrock are not likely to be the same.

Uses of Bedrock-surface Maps

A detailed bedrock-surface map serves three general purposes: (1) It is of immediate practical use to the well driller, for it provides him with information as to the approximate level at which bedrock will be encountered at any given place. (2) It shows the position of bedrock valleys and thus outlines areas of possible production of water from glacial gravels. (3) It is of basic significance in understanding and estimating the shallow groundwater resources of an area.

The extent to which bedrock-surface maps have been used by drillers is uncertain, but it seems probable that they have been used only to a limited degree. This arises largely from the fact that bedrock-surface maps are available only for limited areas within the State and also from the fact that drillers by long experience have accumulated their own information as to the variations in depth to the rock surface in their particular areas.

In considering the shallow groundwater resources of an area the bedrock-surface map is used as a basis for outlining the areas where sizable reservoirs of water-bearing sand and gravel in the drift may be encountered. It is an important guide to additional earth-resistivity surveys and a program of test-drilling to increase groundwater supplies. It reveals the general areas where the bedrock map be more than usually water-bearing because of the nearness of sand and gravel deposits which serve as conduits of water for recharge of the bedrock aquifers.

Near Joliet water-bearing horizons in the shallow limestone wells seem to be closely related to the contours of the bedrock surface, and it is believed that these levels may be predicted with fair accuracy from the bedrock-surface maps alone. There is also evidence which indicates that the water-bearing solution-cavities in the limestones are most highly developed in the upper 50 feet of bedrock along and adjacent to these ancient valleys. One would thus anticipate highest yields from shallow limestone wells close to the valleys and

lower yields from wells on the old bedrock uplands where the limestone is less permeable and porous. An additional reason for believing that higher yields may be expected in the vicinity of bedrock valleys is based on known geologic relations. Dye-tests and comparison of static levels in drift wells and limestone wells have shown that the water-filled openings in the limestone are usually connected directly with water in the glacial drift and that an unconfined saturated zone extends from one to the other. It therefore follows that porous limestone aquifers will be more rapidly recharged where they are overlain by water-charged bodies of sand and gravel than where they are overlain by till which contains but little water. Thus in general, better limestone wells are possible in areas where sand and gravel overlies the rock.

Water Possibilities

Although the main bulk of glacial drift in the Joliet area is made up of till which contains insignificant amounts of water, water-bearing sand and gravel fills are usually present within the bedrock valleys. These fills vary greatly in extent and thickness, depending upon the size of the valley and geological relations, and they form the best sources of water in the glacial drift.

The bedrock-valley fills cover wide areas and range in thickness from only a few feet to as much as 150 feet (pls. 2 and 3). The thickest and most continuous fills occur along the bedrock valleys of Spring and Hickory creeks and along Hadley bedrock valley. Where detailed drillers' logs or sample studies are available, the fill is known to consist largely of sand with important amounts of gravel. Locally in Joliet the gravel beds are cemented to form a conglomerate which is exposed at the surface along Spring and Hickory creeks and which has been reported in numerous wells as "hardpan." As far as can be determined, the fill in the eastern part of Hadley bedrock valley seems to be irregular in distribution and contains a large proportion of sand and silt. Thick deposits of silt in this part of the valley, coupled with the great depth to bedrock, have caused difficulties in drilling.

The conditions which must be met before a large reserve of water can be established with certainty are (1) the presence of a large deposit which is porous and in which connected openings allow the passage of water, (2) the deposit must lie below the groundwater table of the region so that it is permanently saturated, and (3) the deposit must be connected with conduits from the intake areas so that the rate of groundwater recharge will equal the rate of withdrawal. The present study in the Joliet area has served to indicate the position and thickness of potentially important aquifers lying below the groundwater table. The other factors relating to porosity, permeability, and movement of groundwater are largely unknown and can be determined only by pumping tests and a planned program of test drilling.

No attempt has been made to estimate accurately the water reserves present in the drift. Too many important factors are as yet unknown. However, significant reserves are probably present and they should be considered in any estimate of the water resources, particularly for industrial and municipal needs. Their development will depend largely on these needs.

Prior to 1913 the City of Joliet produced water from the thin western margin of the Hickory Creek bedrock-valley deposit. About 20 drive-points, all less than 40 feet deep, were sunk in the vicinity of the Washington Street pumping station, and at this time they are reported to have produced an estimated 1,250,000 gallons per day. They continued in use even after the deep city wells were drilled and are pumped intermittently at the present time. This suggests the scale of production which can be obtained from the gravel-filled bedrock valleys and the extent to which they constitute a potential reserve of groundwater for the Joliet area.